Joliet Army Ammunition Plant
Joliet
Will County
Illinois

HAER No. IL-18

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
Department of the Interior
Washington, DC 20013-7127

HISTORIC AMERICAN ENGINEERING RECORD

Joliet Army Ammunition Plant

IL-18

Location:	In Will County, Illinois, approximately fifteen miles south of Joliet, east of the Des Plaines River.
Date of Construction:	Established in 1940.
Owner:	Department of the Army
Significance:	Joliet Army Ammunition Plant was one of the first munitions facilities established in the United States after the outbreak of World War II in Europe. Its TNT manufacturing buildings represent the first of widely used industrial process, and are a highly intact historic-engineering type.
Historical Report Prepared by:	Peter Rathbun, 1984.
Prepared for Transmittal by:	Robie S. Lange, HABS/HAER, 1985.

EXECUTIVE SUMMARY

The Joliet Army Ammunition Plant (JAAP), a part of the Army's Armament, Munitions and Chemical Command (AMCCOM), is a government-owned, contractor-operated (GOCO) installation located near Joliet, Illinois. One of a series of plants constructed between 1940 and 1943 for the U.S. Army, the JAAP was expanded during the Korean and Vietnam wars and is currently on standby and modernization status. Under the direction of Uniroyal Corporation, the current operating contractor, modernization activities include the construction of improved waste-handling facilities and the limited modification of existing production equipment. Present facilities include production lines for TNT, DNT, tetryl, sulfuric and nitric acids, and sellite, and lines for loading, assembling, and packing ammunition.

The 23,544-acre site presently contains 1,391 buildings, 1,138 of which date from World War II and house equipment from that era. The majority of the buildings were constructed for temporary use and are utilitarian in nature. There are no Category I or II historic properties at the JAAP. The manufacturing buildings of TNT Line 7 (Buildings 801-7, 803-7, 802-7, 812-7, 806-7, 808-4) are Category III historic properties because they represent the first of a widely used industrial process and are a highly intact historic engineering type.

CONTENTS

PREFACE

This report presents the results of an historic properties survey of the Joliet Army Ammunition Plant (JAAP). Prepared for the United States Army Materiel Development and Readiness Command (DARCOM), the report is intended to assist the Army in bringing this installation into compliance with the National Historic Preservation Act of 1966 and its amendments, and related federal laws and regulations. To this end, the report focuses on the identification, evaluation, documentation, nomination, and preservation of historic properties at the JAAP. Chapter 1 sets forth the survey's scope and methodology; Chapter 2 presents an architectural, historical, and technological overview of the installation and its properties; and Chapter 3 identifies significant properties by Army category and sets forth preservation recommendations. Illustrations and an annotated bibliography supplement the text.

This report is part of a program initiated through a memorandum of agreement between the National Park Service, Department of the Interior, and the U.S. Department of the Army. The program covers 74 DARCOM installations and has two components: 1) a survey of historic properties (districts, buildings, structures, and objects), and 2) the development of archaeological overviews. Stanley H. Fried, Chief, Real Estate Branch of Headquarters DARCOM, directed the program for the Army, and Dr. Robert J. Kapsch, Chief of the Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) directed the program for the National Park Service. Sally Kress Tompkins was program manager, and Robie S. Lange was

project manager for the historic properties survey. Technical assistance was provided by Donald C. Jackson.

Building Technology Incorporated acted as primary contractor to HABS/HAER for the historic properties survey. William A. Brenner was BTI's principal-in-charge and Dr. Larry D. Lankton was the chief technical consultant. Major subcontractors were the MacDonald and Mack Partnership and Jeffrey A. Hess. The author of this report was Peter Rathbun. The author gratefully acknowledges the administrative assistance of John F. Nemanich, Commanding Officer's Representative; the on-site guidance of Arnold Kiser, of the government staff; and the research assistance provided by Robert Spieler and Lloyd Cato of Uniroyal, Inc.

The complete HABS/HAER documentation for this installation will be included in the HABS/HAER collections at the Library of Congress, Prints and Photographs Division, under the designation HAER No. IL-18.

Chapter 1

INTRODUCTION

SCOPE

This report is based on an historic properties survey conducted in October 1983 of all Army-owned properties located within the official boundaries of the Joliet Army Ammunition Plant (JAAP). The survey included the following tasks:

- Completion of documentary research on the history of the installation and its properties.

- Completion of a field inventory of all properties at the installation.

- Preparation of a combined architectural, historical, and technological overview for the installation.

- Evaluation of historic properties and development of recommendations for preservation of these properties.

Also completed as a part of the historic properties survey of the installation, but not included in this report, are HABS/HAER Inventory cards for 38 individual properties. These cards, which constitute HABS/HAER Documentation Level IV, will be provided to the Department of the Army. Archival copies of the cards, with their accompanying photographic

negatives, will be transmitted to the HABS/HAER collections at the Library of Congress.

The methodology used to complete these tasks is described in the following section of this report.

METHODOLOGY

1. Documentary Research

The JAAP was one of the first of sixty government-owned ordnance plants constructed during the period 1940-1943. Because it was part of an extensive manufacturing network, an understanding of its historical and technological significance requires a general understanding of the wartime munitions industry. To identify published documentary sources on the American munitions industry during World War II and the Korean and Vietnam wars, research was conducted in standard bibliographies of military history, engineering, and the applied sciences. Unpublished sources were identified by researching the historical and technological archives of the U.S. Army Armament, Munitions and Chemical Command (AMCCOM) at Rock Island Arsenal.[1]

In addition to this general research, a concerted effort was made to locate published and unpublished material dealing specifically with the history and technology of the JAAP. This site-specific research was conducted primarily at the AMCCOM Historical Office at Rock Island

Arsenal, the Joliet Public Library, and the government and contractor files at the JAAP.

Army records used for the field inventory included current Real Property Inventory (RPI) printouts that listed all officially recorded buildings and structures by facility classification and date of construction; the installation's property record cards; base maps and photographs supplied by installation personnel; and installation master planning, archaeological, environmental assessment, and related reports and documents. A complete listing of this documentary material may be found in the bibliography.

2. Field Inventory

The field inventory was conducted in October 1983 by Peter Rathbun and Robert Ferguson. John F. Nemanich provided administrative assistance, Robert Spieler and Lloyd Cato provided research assistance, and Arnold Kiser guided the on-site inspections.

Field inventory procedures were based on the HABS/HAER Guidelines for Inventories of Historic Buildings and Engineering and Industrial Structures.[2] All areas and properties were visually surveyed. Building locations and approximate dates of construction were noted from the installation's property records and field-verified. Interior surveys were made of the major facilities to permit adequate evaluation of architectural features, building technology, and production equipment.

Field inventory forms were prepared for, and black and white 35 mm photographs taken of all buildings and structures through 1945 except basic utilitarian structures of no architectural, historical, or technological interest. When groups of similar ("prototypical") buildings were found, one field form was normally prepared to represent all buildings of that type. Field inventory forms were also completed for representative post-1945 buildings and structures.[3] Information collected on the field forms was later evaluated, condensed, and transferred to HABS/HAER Inventory cards.

3. Historical Overview

A combined architectural, historical, and technological overview was prepared from information developed from the documentary research and the field inventory. It was written in two parts: 1) an introductory description of the installation, and 2) a history of the installation by periods of development, beginning with pre-military land uses. Maps and photographs were selected to supplement the text as appropriate.

The objectives of the overview were to 1) establish the periods of major construction at the installation, 2) identify important events and individuals associated with specific historic properties, 3) describe patterns and locations of historic property types, and 4) analyze specific building and industrial technologies employed at the installation.

4. Property Evaluation and Preservation Measures

Based on information developed in the historical overviews, properties were first evaluated for historical significance in accordance with the eligibility criteria for nomination to the National Register of Historic Places. These criteria require that eligible properties possess integrity of location, design, setting, materials, workmanship, feeling, and association, and that they meet one or more of the following:[4]

A. Are associated with events that have made a significant contribution to the broad patterns of our history.

B. Are associated with the lives of persons significant in the nation's past.

C. Embody the distinctive characteristics of a type, period, or method of construction, represent the work of a master, possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction.

D. Have yielded, or may be likely to yield, information important in pre-history or history.

Properties thus evaluated were further assessed for placement in one of five Army historic property categories as described in Army Regulation 420-40:[5]

Category I	Properties of major importance
Category II	Properties of importance
Category III	Properties of minor importance
Category IV	Properties of little or no importance
Category V	Properties detrimental to the significance of adjacent historic properties.

Based on an extensive review of the architectural, historical, and technological resources identified on DARCOM installations nationwide, four criteria were developed to help determine the appropriate categorization level for each Army property. These criteria were used to assess the importance not only of properties of traditional historical interest, but also of the vast number of standardized or prototypical buildings, structures and production processes that were built and put into service during World War II, as well as of properties associated with many post-war technological achievements. The four criteria were often used in combination and are as follows:

1) Degree of importance as a work of architectural, engineering, or industrial design. This criterion took into account the qualitative factors by which design is normally judged: artistic merit, workmanship, appropriate use of materials, and functionality.

2) Degree of rarity as a remaining example of a once widely used architectural, engineering, or industrial design or process. This criterion was applied primarily to the many standardized or prototypical DARCOM buildings, structures, or industrial processes. The more widespread or influential the design or process, the greater the importance of the remaining examples of the design or process was considered to be. This criterion was also used for non-military structures such as farmhouses and other once prevalent building types.

3) Degree of integrity or completeness. This criterion compared the current condition, appearance, and function of a building, structure, architectural assemblage, or industrial process to its original or most historically important condition, appearance, and function. Those properties that were highly intact were generally considered of greater importance than those that were not.

4) Degree of association with an important person, program, or event. This criterion was used to examine the relationship of a property to a famous personage, wartime project, or similar factor that lent the property special importance.

The majority of DARCOM properties were built just prior to or during World War II, and special attention was given to their evaluation. Those that still remain do not often possess individual importance,

but collectively they represent the remnants of a vast construction undertaking whose architectural, historical, and technological importance needed to be assessed before their numbers diminished further. This assessment centered on an extensive review of the military construction of the 1940-1945 period, and its contribution to the history of World War II and the post-war Army landscape.

Because technology has advanced so rapidly since the war, post-World War II properties were also given attention. These properties were evaluated in terms of the nation's more recent accomplishments in weaponry, rocketry, electronics, and related technological and scientific endeavors. Thus the traditional definition of "historic" as a property 50 or more years old was not germane in the assessment of either World War II or post-war DARCOM buildings and structures; rather, the historic importance of all properties was evaluated as completely as possible regardless of age.

Property designations by category are expected to be useful for approximately ten years, after which all categorizations should be reviewed and updated.

Following this categorization procedure, Category I, II, and III historic properties were analyzed in terms of:

- Current structural condition and state of repair. This information was taken from the field inventory forms and

photographs, and was often supplemented by rechecking with facilities engineering personnel.

- The nature of possible future adverse impacts to the property. This information was gathered from the installation's master planning documents and rechecked with facilities engineering personnel.

Based on the above considerations, the general preservation recommendations presented in Chapter 3 for Category I, II, and III historic properties were developed. Special preservation recommendations were created for individual properties as circumstances required.

5. Report Review

Prior to being completed in final form, this report was subjected to an in-house review by Building Technology Incorporated. It was then sent in draft to the subject installation for comment and clearance and, with its associated historical materials, to HABS/HAER staff for technical review. When the installation cleared the report, additional draft copies were sent to DARCOM, the appropriate State Historic Preservation Officer, and, when requested, to the archaeological contractor performing parallel work at the installation. The report was revised based on all comments collected, then published in final form.

NOTES

1. The following bibliographies of published sources were consulted: Industrial Arts Index, 1938-1957; Applied Science and Technology Index, 1958-1980; Engineering Index, 1938-1983; Robin Higham, ed., A Guide to the Sources of United States Military History (Hamden, Conn.: Archon Books, 1975); John E. Jessup and Robert W. Coakley, A Guide to the Study and Use of Military History (Washington, D.C.: U.S. Government Printing Office, 1979); "Military Installations," Public Works in the United States, eds. Suellen M. Hoy and Michael C. Robinson (Nashville: American Association for State and Local History, 1982), pp. 380-400. AMCCOM (formerly ARRCOM, or U.S. Army Armament Materiel Readiness Command) is the military agency responsible for supervising the operation of government-owned, contractor-operated munitions plants; its headquarters are located at Rock Island Arsenal, Rock Island, Illinois. Although there is no comprehensive index to AMCCOM archival holdings, the agency's microfiche collection of unpublished reports is itemized in ARRCOM, Catalog of Common Sources, Fiscal Year 1983, 2 vols. (no pl.: Historical Office, AMCCOM, Rock Island Arsenal, n.d.).

2. Historic American Buildings Survey/Historic American Engineering Record, National Park Service, Guidelines for Inventories of Historic Buildings and Engineering and Industrial Structures (unpublished draft, 1982).

3. Representative post-World War II buildings and structures were defined as properties that were: (a) "representative" by virtue of construction type, architectural type, function, or a combination of these, (b) of obvious Category I, II, or III historic importance, or (c) prominent on the installation by virtue of size, location, or other distinctive feature.

4. National Park Service, How to Complete National Register Forms (Washington, D.C.: U.S. Government Printing Office, January 1977).

5. Army Regulation 420-40, Historic Preservation (Headquarters, U.S. Army: Washington, D.C., 15 April 1984).

Chapter 2

HISTORICAL OVERVIEW

BACKGROUND

The Joliet Army Ammunition Plant (JAAP) is a government-owned, contractor-operated munitions manufacturing facility situated on 23,544 acres about fifteen miles south of Joliet, Illinois (Figure 1). The facility was originally two separate plants -- the Kankakee Ordnance Works and the Elwood Ordnance Plant -- each with its own administration and support facilities. In 1946 the two plants combined to form Joliet Arsenal, which was renamed Joliet Army Ammunition Plant in 1963.[1]

Constructed in 1940-1942, the Kankakee Ordnance Works (Figure 2) produced and stored the explosives trinitrotoluene (TNT), dinitrotoluene (DNT), lead azide, and tetryl. The Elwood Ordnance Plant (Figure 3), also constructed in 1940-1942, loaded, assembled, and packed bombs and artillery ammunition. Both units operated from September 1941 until August 1945, when they were placed on standby. The consolidated plant, reactivated for the Korean War, remained in production from 1952 to 1957. Rehabilitation for the Vietnam War began in 1965, and full production resumed. Modernization of major segments of the explosives production plant began in 1970 and was completed before output ended in 1976. Since then the plant has been in layaway.[2]

Of 1,391 major buildings at the JAAP, 1,138 date from World War II.[3] Although much of the original equipment has been replaced or modernized, some significant World War II production lines remain intact.

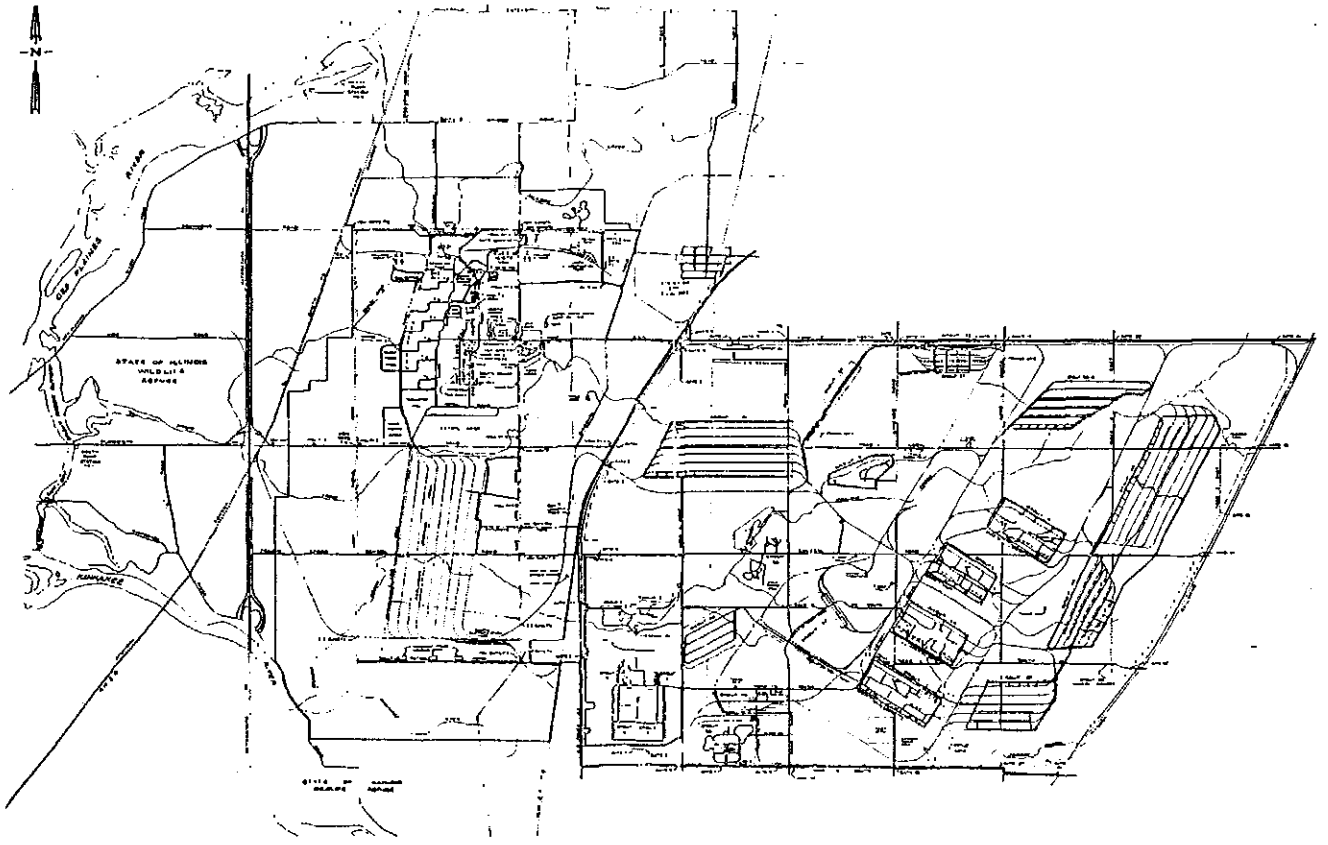

Figure 1: JAAP, Current Site Plan. (Source: Contractor files, JAAP)

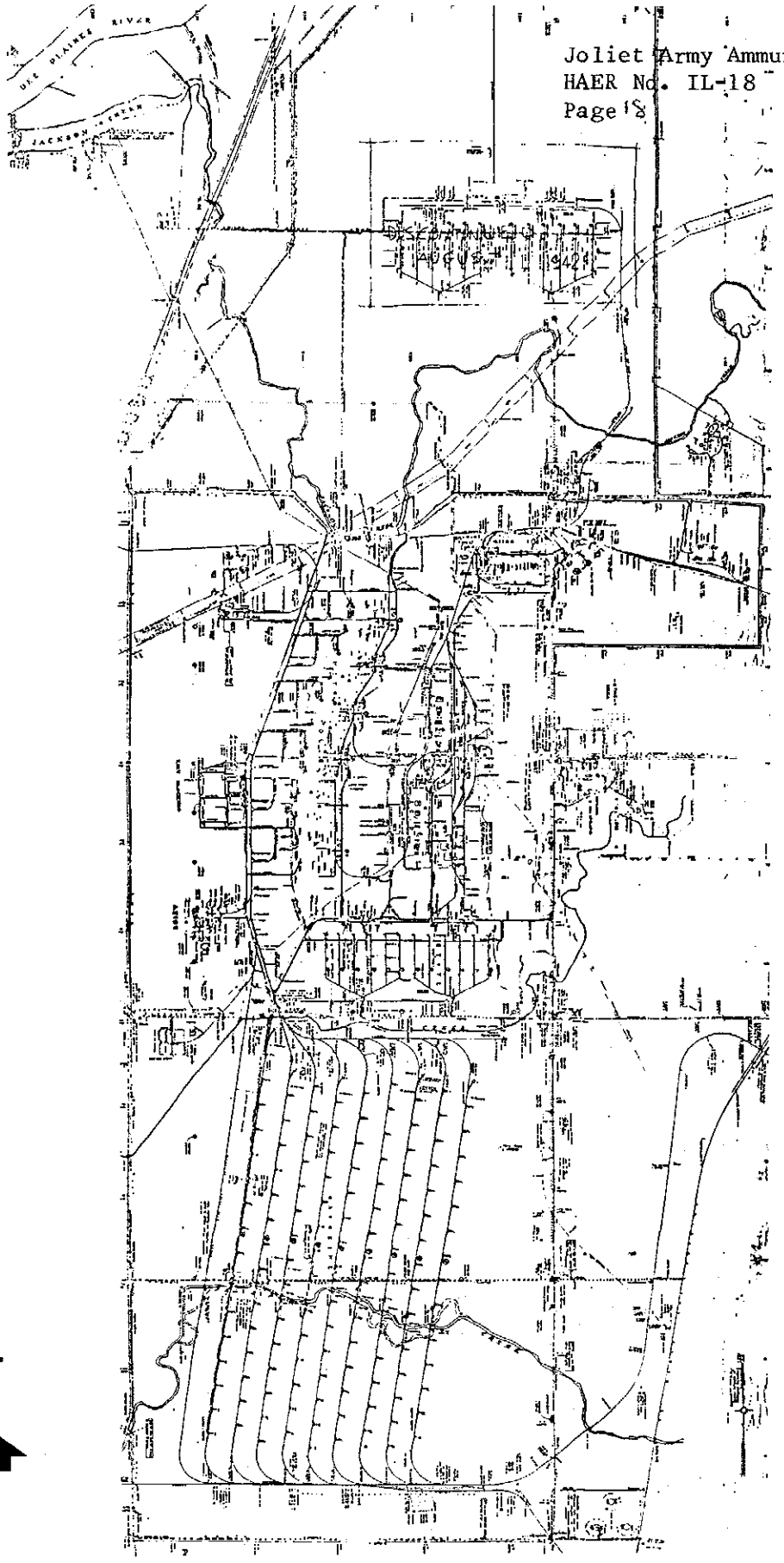

Figure 2: Kankakee Ordnance Works, Site Plan, 1946. (Source: Contractor files, JAAP)

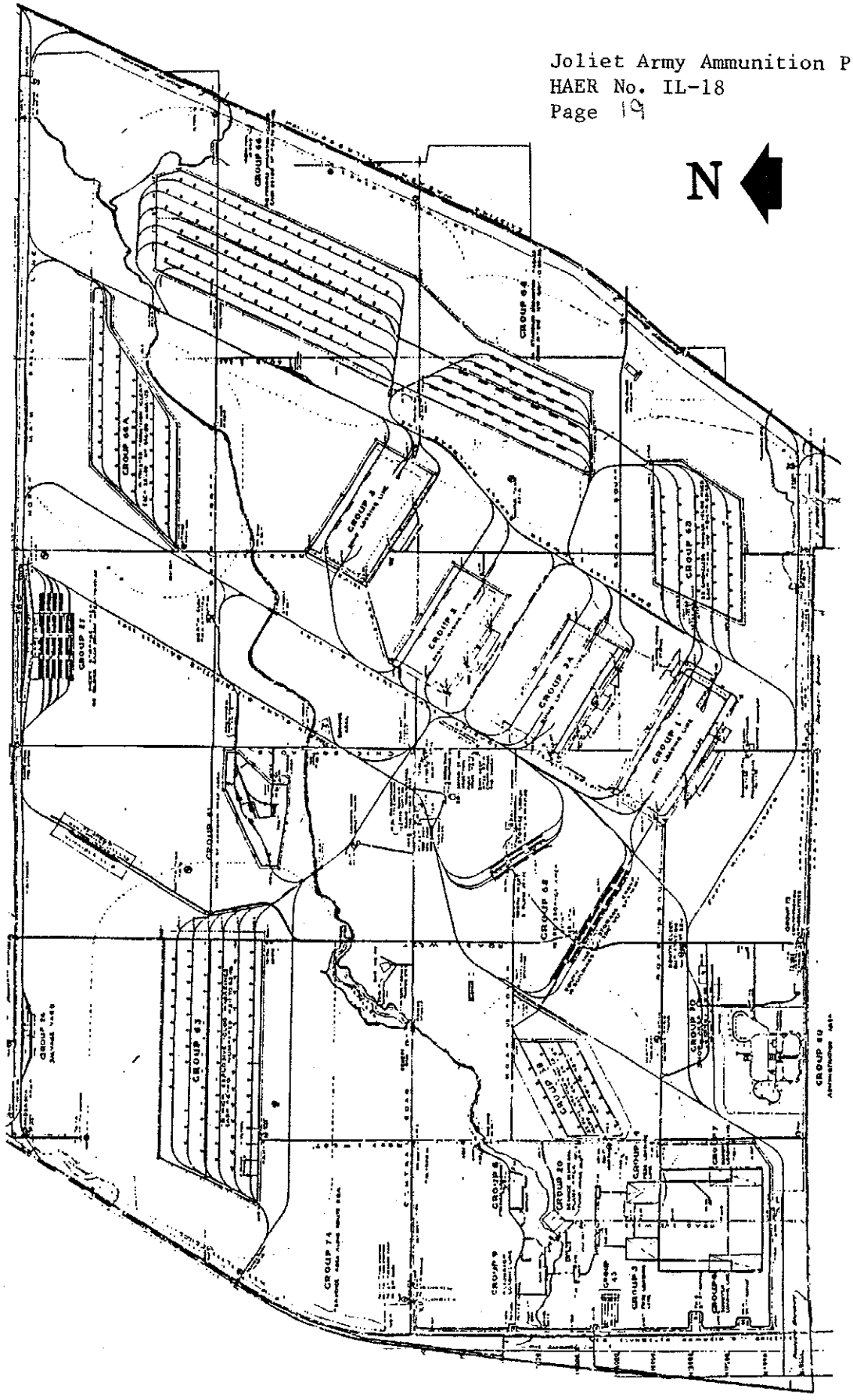

Figure 3: Elwood Ordnance Plant, Site Plan, 1941. (Source: Contractor files, JAAP)

For a more detailed understanding of the JAAP's architectural and technological history, it is necessary to look more closely at the plant's three major production periods: World War II, the Korean War, and the Vietnam War.

WORLD WAR II

When war broke out in Europe in the fall of 1939, the United States had almost no industrial capacity for manufacturing military ammunition. As historians Harry C. Thomson and Lida Mayo observe in their authoritative work on American munitions production:

> Only a handful of small plants were making propellant powder and high explosives, and there were virtually no facilities for the mass loading and assembling of heavy ammunition. American industry was just beginning, through educational orders, to learn techniques for forging and machining shells and producing intricate fuze mechanisms. The only sources for new artillery ammunition were Frankford and Picatinny Arsenals, while a few ordnance depots were equipped to renovate old ammunition. Private [military] ammunition plants did not exist, and, because of the specialized nature of the process, there were no commercial plants that could be converted to ammunition production.
>
> To meet this situation the Ordnance Department took steps in the summer of 1940 to create something new in American economic life -- a vast interlocking network of ammunition plants owned by the government and operated by private industry. More than 60 of these GOCO (government-owned, contractor-operated) plants were built between June 1940 and December 1942.[1]

The Elwood and Kankakee plants were two of the first five plants to be authorized and planned. They began production early in the war even though their construction was plagued by material shortages and labor problems.[5]

The Elwood and Kankakee units of JAAP were built as separate plants because their roles in the munitions process differed. Kankakee produced various explosives: TNT, the basic explosive in most bombs, mines, and ammunition; DNT, for use by other ordnance plants in the production of propellant powder; lead azide for primers; and tetryl for booster charges. Kankakee also produced raw materials (sulfuric acid, nitric acid, and sellite) needed for explosives manufacture. Elwood's role was to load artillery shells, bombs, boosters, and fuzes.

Site Selection and Former Land Use

The Army Ordnance Department chose the Joliet area because it satisfied basic criteria that governed selection of all World War II ordnance plant sites. It had:

(1) a location over 200 miles from the coasts or international borders for defensive reasons
(2) raw materials nearby
(3) a suitable labor supply
(4) large tracts of land to allow safe separation of facilities and to provide room for expansion
(5) access to main highways and rail lines
(6) adequate electrical power
(7) an ample supply of water for processing.[6]

Before the site was acquired for JAAP, it was primarily used for farming.[7] Included in the purchase were six cemeteries, one of which -- Reed Cemetery

-- was associated with the first white settlement in the county. The operating contractor still maintains these cemeteries.

The only buildings still existing from the pre-military period are ten farmhouses, now used for staff housing. Buildings 60-62 through 60-69 are two-story, wood-frame houses dating from the late nineteenth and early twentieth centuries. These eight houses have rectangular plans and hip or gable roofs, some with cross gables or dormers. Since the porches are uniform, and resemble those of standard military housing of the World War II period, it is likely that they were added in late 1940 or early 1941, when the houses were moved from their original locations to the east residential area of Group 60 (the Administration Group of the Elwood Unit). Buildings 74-1 and 74-2 are of brick or brick veneer construction, and appear to date from the early twentieth century. Both of these two-story houses remain on their original sites on U.S. Highway 63 near the southwest corner of the Elwood Unit. The ten houses are in good physical condition, but all show signs of alteration. None have any historical or architectural importance.

Construction

In September 1940 the Army Ordnance Department authorized a contract with Stone and Webster Engineering Corporation of New York City for construction of Kankakee Ordnance Works. A contract with Sanderson and Porter, also of New York City, to build Elwood Ordnance Plant came soon after. Each firm served both as architect-engineer and construction contractor.[8]

Designing for different functions, the two firms used different building types for their respective plants. Most production buildings at Elwood were framed in steel or concrete, with structural clay tile walls and corrugated asbestos roofing. Reinforced concrete explosion walls, usually extending beyond the walls and roof of a building, separated bays housing particularly hazardous production steps.

The smaller, more numerous Kankakee buildings had steel structural framing and wood subframing, and were roofed and clad with asbestos-cement tiles and panels. Floors in most production buildings were covered with lead to protect them from the acids used in the manufacturing processes. Concrete foundations were common to both plants, as were storage or utility buildings framed in steel or wood and clad with 4' x 8' corrugated asbestos-cement panels.

Explosive and ammunition storage magazines at both plants were the standard earth-bermed, barrel-vaulted, reinforced-concrete "igloos," with rail access, laid out according to standard Army Ordnance plans. Four such igloos at Kankakee were altered in 1944: the addition of doors and loading docks at their back sides made these magazines accessible to trucks[9] (Figure 4).

The Ordnance Department named Sanderson and Porter operating contractor for the Elwood plant, and appointed E. I. du Pont de Nemours & Company, Inc., of Wilmington, Delaware, operating contractor for the Kankakee plant. Du Pont also provided architecture-engineering consultant services for the

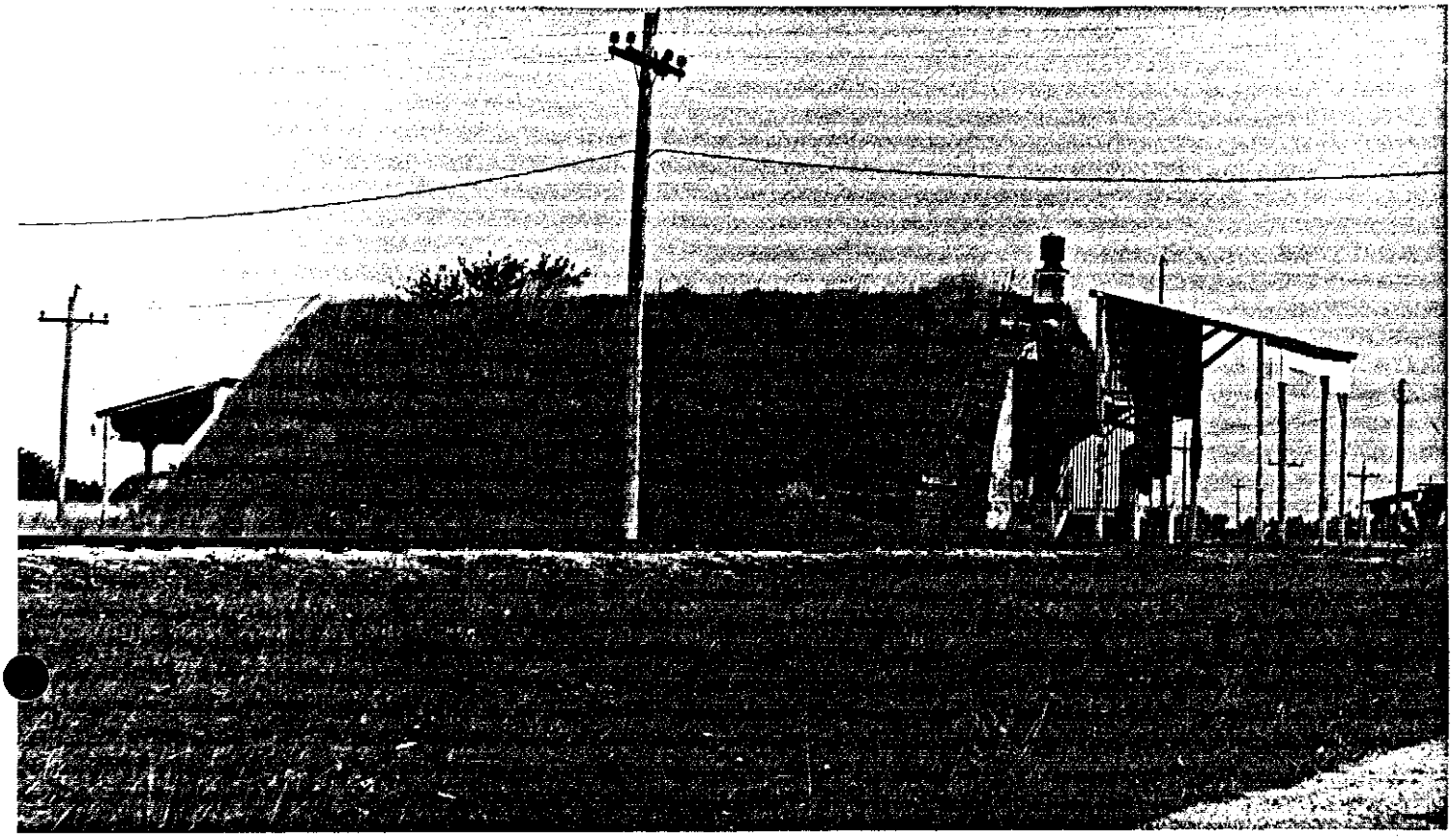

Figure 4: High explosive magazine (Building 811-125) converted to loading dock. (Source: Field inventory photograph, Peter Rathbun, MacDonald and Mack Partnership, 1983)

construction of the explosives manufacturing areas at Kankakee. The du Pont firm, very experienced in the producton of explosives and ammunition, developed plans for many of the Army's explosives works. In April 1944, U.S. Rubber Company (later Uniroyal, Inc.) succeeded du Pont as operating contractor of the Kankakee Unit.[10]

Construction work on both plants began in November 1940.[11] Elwood went into operation first, beginning production on Load Line 2 (Buildings 2-1 through 2-43) on 12 July 1941.[12] Because of the urgent need for explosives, the first TNT and DNT lines at Kankakee began operating in September 1941, even though construction was still underway on other lines.[13]

The buildings of both plants were organized into separate "areas" (Kankakee) or "groups" (Elwood) based on function. The manufacturing areas at Kankakee, roughly centered within the plant itself (Figure 2), included TNT Areas 1 through 6, with twelve TNT lines and six DNT lines; three Acid Areas numbered 1, 2, and 3; an Oleum Plant at Acid Area 3; Tetryl Areas 1 and 2, with twelve tetryl lines; and smaller areas for lead azide and block TNT production (both now demolished). Located on rolling land in the southern part of the works, the Magazine Area (including Buildings 811-1 through 811-132) at Kankakee covered almost as much land as all the manufacturing areas together. The Shops Area was adjacent to the production areas on the south, and the Administrative Area was to the east on high ground overlooking the central manufacturing section.[14]

At Elwood the shell and bomb production lines -- Groups 1, 3A, 2, and 3 -- were located between storage areas in the southeast corner of the plant (Figure 3). The fuze and booster lines -- Groups 4, 5, 6, and 7 -- were in the southwest corner of the plant. The final production area, Group 61, was built to produce ammonium nitrate and was located in the north central part of the plant. Explosives magazines (Group 63), inert storage warehouses for nonexplosive shell and bomb components (Groups 27 and 62), fuze and booster magazines (Group 68), smokeless powder magazines ((Group 65), and finished ammunition storage magazines (Groups 64, 66 and 66A) were scattered throughout the site. The Administrative and Shops Groups (Groups 60 and 70) were located in the southwest corner of the plant just east of the Fuze and Booster Groups.[15]

In compliance with principles developed by Army Ordnance, the designers of both Elwood and Kankakee used industrial function and safety as primary criteria for laying out the facilities. Production areas and groups were made up of extended, linear arrangements of widely-spaced buildings. Each ammunition manufacturing group comprised one such "line," while each explosives manufacturing area included a number of lines. Within each line, every step in the manufacturing process was generally performed in a separate building, removed from others by substantial distances. Lines, and groups or areas, were likewise separated to prevent fire spread or sympathetic explosions. The Ordnance Department supplied precalculated tables for determining the distances needed and the number and placement of differing kinds of explosion barricades[16] (Figure 5).

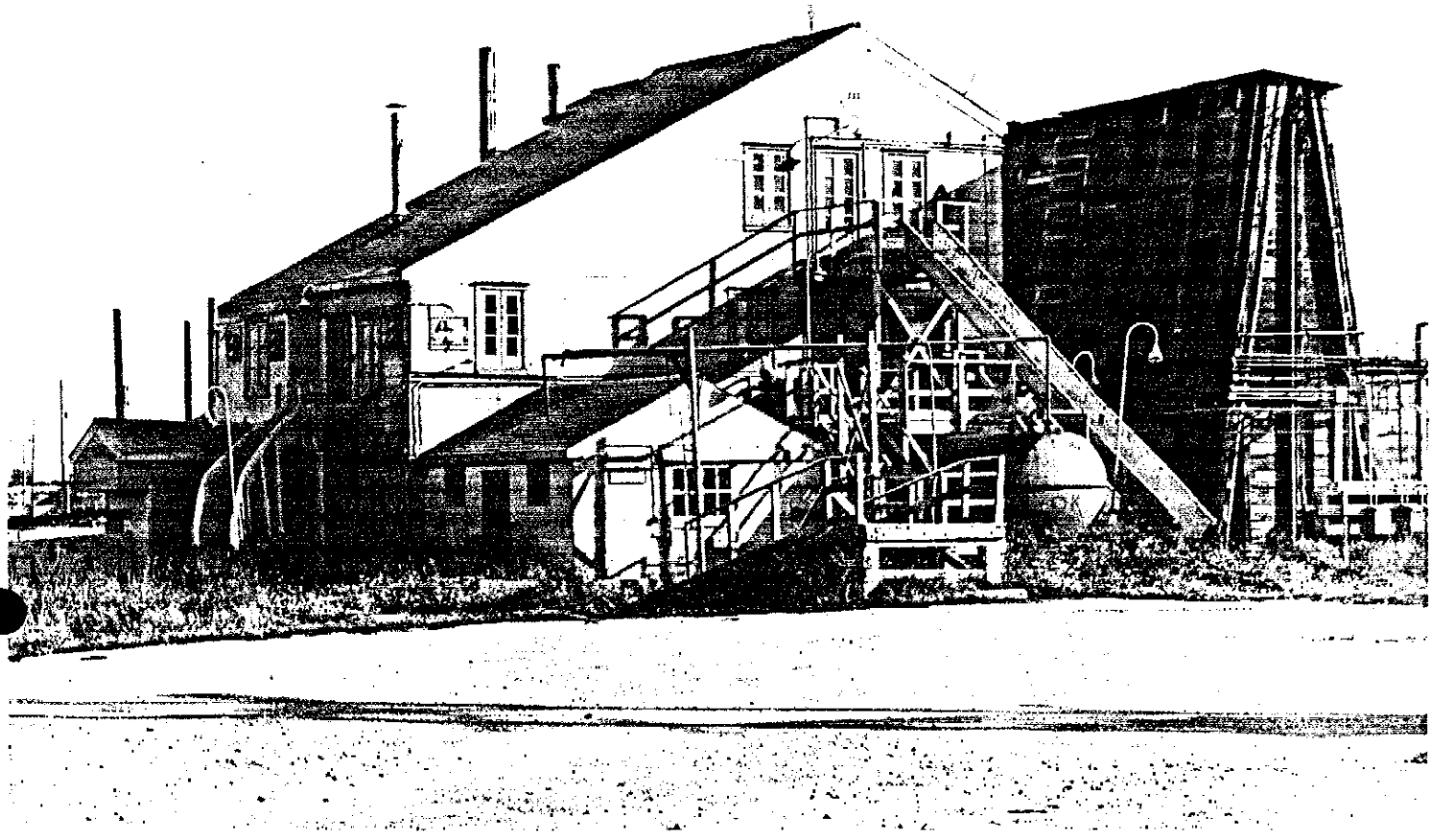

Figure 5: TNT Wash House (Building 806-7), with barricade. (Source: Field inventory photograph, Peter Rathbun, MacDonald and Mack Partnership, 1983)

In the explosives manufacturing lines at Kankakee, individual buildings were connected by piping or concrete walkways for hand-pushed wagons. Buildings on the assembling and loading lines at Elwood were connected by "ramps" enclosing monorail conveyors (Figure 6). Group 3, a shell- and bomb-loading line (Buildings 3-1 through 3-50), extended almost two-thirds of a mile (Figure 7). The fuze, booster, and primer lines handled smaller products that did not involve melting and pouring explosives. These groups were thus somewhat smaller, although similar in arrangement (Figure 8).

Technology

Kankakee Production: Du Pont took control of the first TNT line on 26 September 1941, and began producing explosive soon after.[17] Production continued until August 1945, with a maximum output of over 5.5 million tons of TNT per week.[18]

The basic process for manufacturing TNT was relatively simple. Toluene, an organic chemical, was treated with nitric acid to produce crude trinitrotoluene. The TNT was then purified in a washing process using soda ash, sellite (a compound made from soda ash and sulfur), and water. Finally, the TNT was dried, flaked, and readied for storage. Sulfuric acid was used as a dehydration agent during the manufacturing process. The manufacture of DNT was similar and required the same raw materials. The production of tetryl required the same acids as TNT, along with dimethylaniline, a product of coal or natural gas. This process also used acetone in the purification stage. The lead azide production line used sodium, lead, and cellulose compounds.[19] Kankakee bought its supplies of

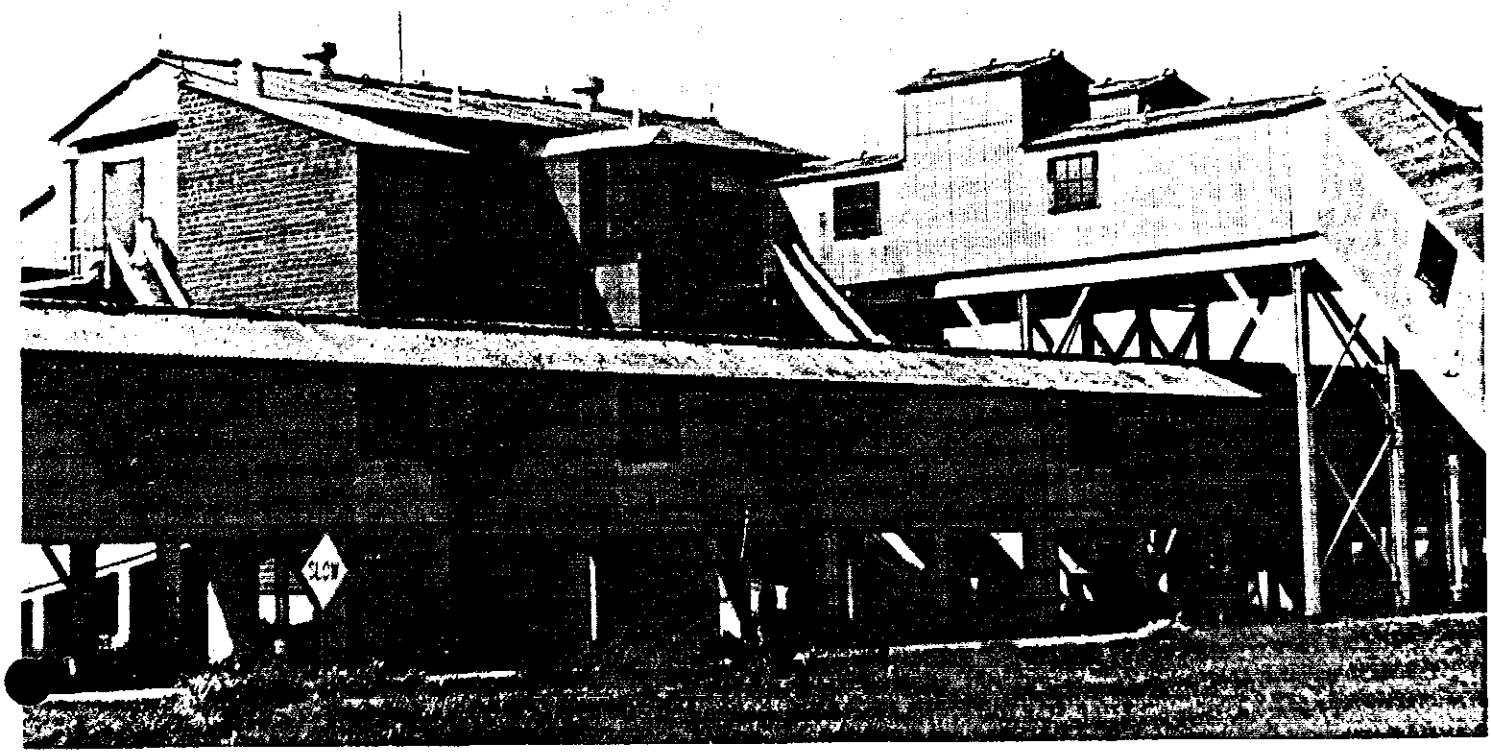

Figure 6: Enclosed "ramps" around Cooling Building (Building 1-16). (Source: Field inventory photograph, Robert Ferguson, MacDonald and Mack Partnership, 1983)

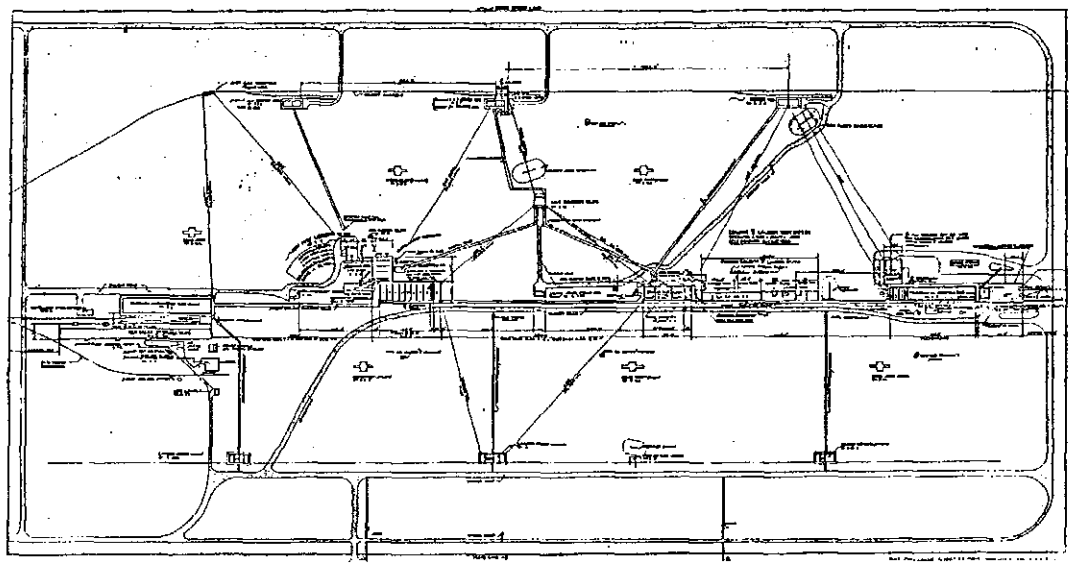

Figure 7: Elwood Ordnance Plant, Group 3, loading line, Site Plan. (Source: Contractor files, JAAP)

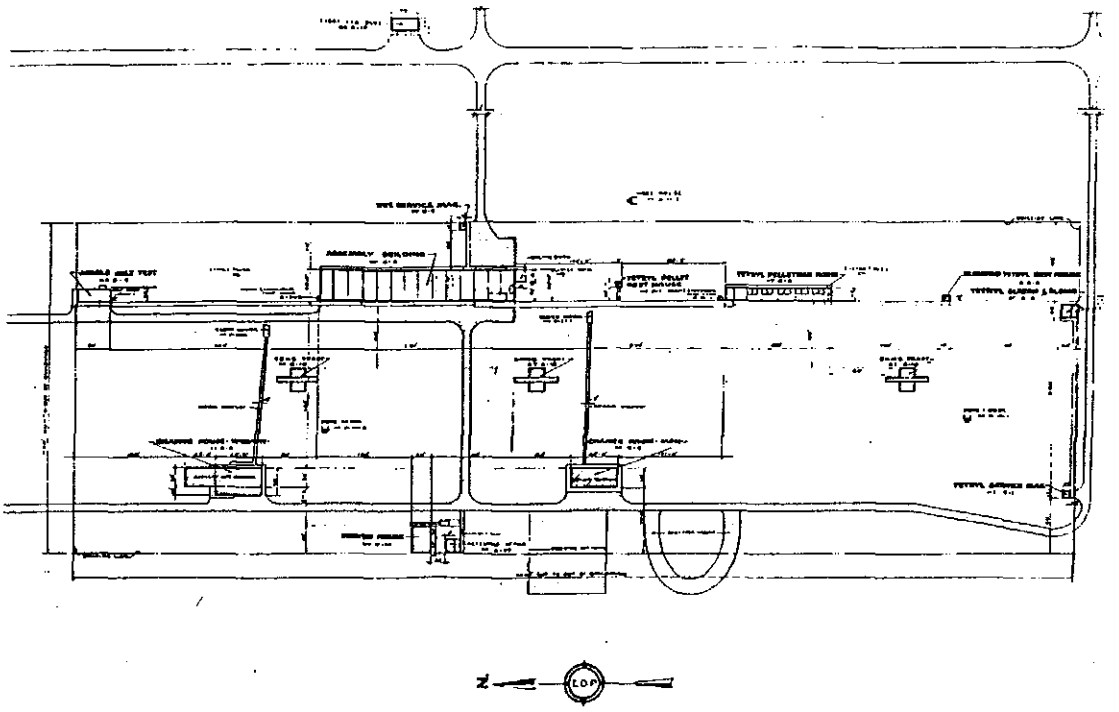

Figure 8: Elwood Ordnance Plant, Group 6, booster assembly line, Site Plan. (Source: Contractor files, JAAP)

toluene, soda ash, dimethylaniline, acetone, and sodium, lead, and cellulose compounds from outside vendors. The plant produced other raw materials itself. Two -- nitric acid and sulfuric acid -- deserve special mention.

Hercules Powder Company, of Wilmington, Delaware, designed the nitric acid production system used at Kankakee. This system employed a commonly used technology developed by du Pont in the 1920s. The Ammonia Oxidation Plants (Buildings 302-1-1 through 302-2-3) produced strong nitric acid by vaporizing ammonia mixed with heated compressed air in the presence of a platinum catalyst to create nitrogen oxides. These oxides reacted with water in absorption towers to form 60% nitric acid. Like most industrial uses of this acid, the manufacture of TNT required a very high concentration. The Nitric Acid Concentrators (Buildings 303-1, 303-2) concentrated the 60% nitric acid by dehydrating it with strong sulfuric acid, which absorbed water from the nitric acid.[20]

The JAAP produced sulfuric acid at the Oleum Plant (Buildings 1501-1, 1501-2) through the contact process, which had become important in this country in the 1930s. Sulfur was burned to produce sulfur dioxide, which was converted to sulfur trioxide as it passed over a platinum catalyst. The sulfur trioxide was then mixed with water to form sulfuric acid.[21] Dilute sulfuric acid from the manufacturing lines was concentrated either in Chemico drum-type concentrators (Buildings 308-1-4, 308-3-1, 308-3-6), which removed water by blowing hot combustion gasses through the acid, or in Mantius concentrators (Buildings 308-1-1, 308-2-1), which removed water through boiling in a vacuum.[22]

Although the chemistry of TNT production remained constant during World War II, the technology underwent significant change. In the early stages of the war, the acid was added to the toluene mix, a process known as nitration. It later was discovered, however, that the toluene could be added to the acid, a "reverse nitration" process that was safer and increased production. Each of these processes will be described briefly, along with the impact of the change on the buildings.

As initially designed, the TNT-production process (Figure 9) began in the Mono House (Buildings 801-1 through 801-12), where nitric acid and a small amount of sulfuric acid were slowly added to toluene in an agitation tank. In this step the toluene, reacting with nitric acid, became mononitrotoluene, or "mono oil." Because of the danger of overheating during this exothermic reaction, the mixing tank was elevated to permit dumping of "hot" mixtures into a drowning tank. The mono oil was piped to the Bi-and-Tri House (Buildings 802-1 through 802-12), while the spent acids were sent to the Acid-and-Fume Recovery House (Buildings 812-1 through 812-12) before returning to the acid areas for concentration. In the Bi-and-Tri House the oil was blended with successively stronger acid mixes.[23] Here, too, mixing tanks were elevated to permit drowning in case of overheating. The nitrotoluenes and spent acids were allowed to separate by gravity, the process oil moving on for purification while the acids were sent to the Fortifying House (Buildings 803-1 through 803-12). The crude TNT was purified in the Wash House (Buildings 806-1 through 806-12 / Figure 5) by washing with a mixture of water, soda ash, and sellite. The purified TNT was then dried, flaked, and loaded into boxes for conveyance to the

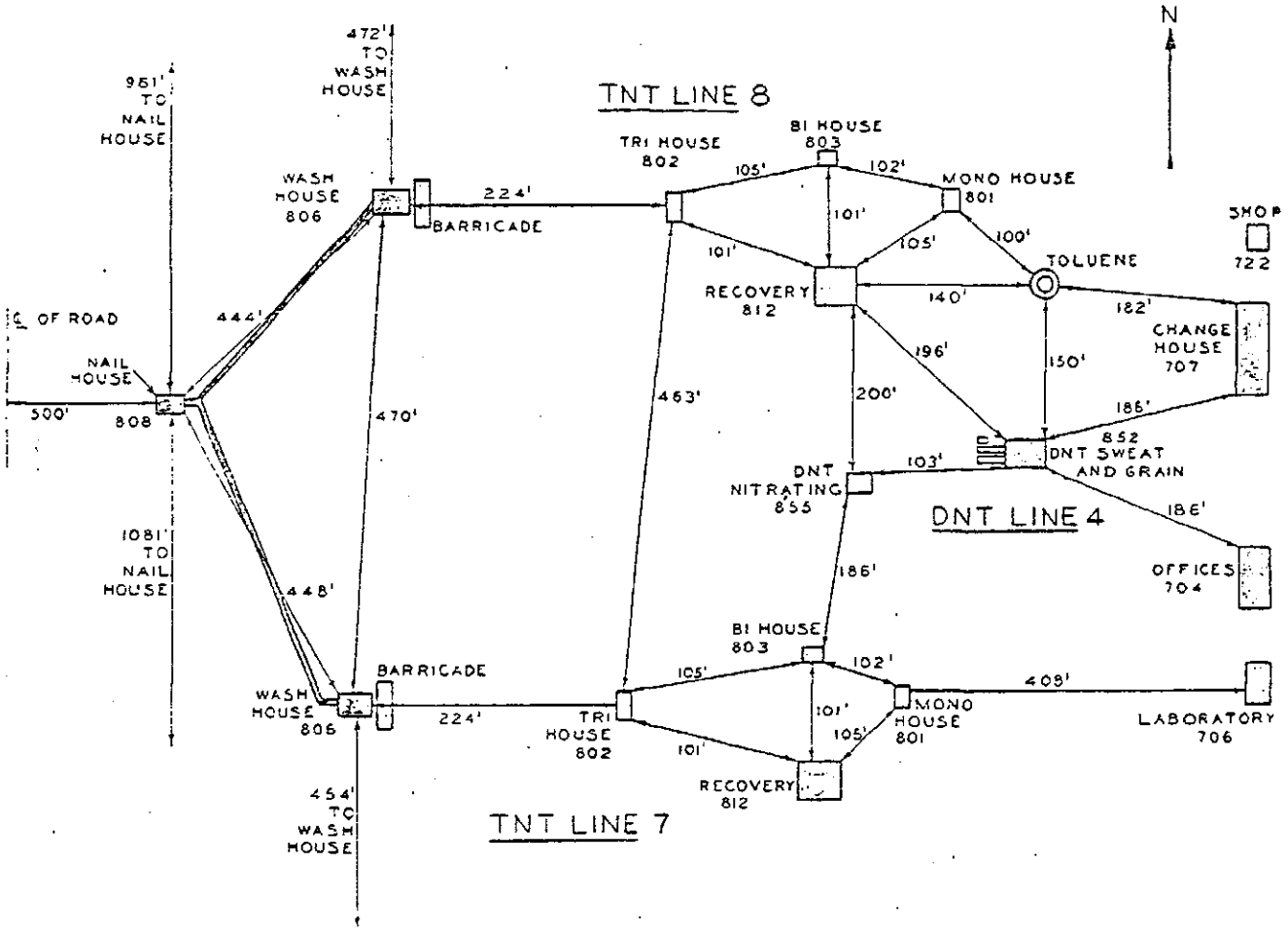

Figure 9: Kankakee Ordnance Works, TNT Lines 7 and 8. (Source: Contractor files, JAAP)

Nail House (Buildings 808-1 through 808-6), where it was sampled and prepared for final shipment.[24]

The reverse nitration process used later allowed the toluene to be added to the acid. This resulted in a more complete nitration in the mono- and bi-stages and reduced the fuming and much of the danger of the tri-nitration. To permit use of reverse nitration in the bi- stage, the Fortifying Houses were converted to Bi-Houses; no drowning tanks could be installed in these one-story buildings. Creation of the Bi-Houses freed both mixers in the Bi-and-Tri Houses for the tri-nitration operation, resulting in re-designation of the latter buildings as Tri-Houses.[25]

For a short time during the war Kankakee's TNT lines 9 and 10 converted to the production of nitroxylene, but before the end of the war they reverted to TNT production. TNT lines were well-suited for the nitration of xylene, which is chemically similar to toluene.[26]

Because the DNT process used toluene and the same acid mix as the TNT process, and because nitrated toluene from the DNT process could be used in the TNT process, the DNT lines were located between the TNT lines (Figure 9). In the DNT Nitrating House (Buildings 855-1 through 855-6) toluene was nitrated into crude dinitrotoluene, and then washed. In the Sweat and Grain House (Buildings 852-1 through 852-6), the DNT oil was cooled in a sweat pan to crystallize the DNT. The waste oil was recycled in the TNT process. The solid DNT was reheated and cooled in a graining kettle to form a powder, ready for packing and storage.[27]

The tetryl lines operated in two groups of six. For each group there was one Sulfating House (Buildings 1001-1, 1001-2), one Acid-and-Fume Recovery House (Buildings 1008-1, 1008-2), one Tetryl Box Packing House (Buildings 1009-1-1, 1009-2-1), one Loading House (Buildings 1009-1-2, 1009-2-2), and Laboratories and Supervisor's Offices (Buildings 704-10, 704-11, 707-11, 707-12, 707-16, 707-18). Each line consisted of a Nitrating House (Buildings 1002-1 through 1002-12), a Refinery Building (Buildings 1003-1 through 1003-12), a Lag Storage Building (Buildings 1004-1 through 1004-12), and a Dry and Blower House (Buildings 1005-1 through 1005-12). Manufacture began in the Sulfating House, where dimethylaniline was mixed with strong sulfuric acid to form dimethylaniline sulfate. In the Nitrating House this compound reacted with nitric and sulfuric acids to form tetryl crystals. In the Refinery Building, the crystals were dissolved in acetone and filtered. The refined tetryl was hot-air-dried in the Dry and Blower House and packed for shipment or storage.[28]

The production of lead azide, manufactured in much smaller quantities than TNT, DNT, or tetryl, began by mixing sodium carboxy methol cellulose, sodium azide, and lead acetate separately in the Sodium Azide Manufacture Building (Building 1210) and the Preparation Building (Building 1220). When the solutions were mixed together in the Precipitation Building (Building 1221) with empilon soap, lead azide precipitated out of the solution. It was bagged and packed in barrels in Building 1223.[29]

Elwood Production: The Elwood Ordnance Plant performed two main activities. Four lines loaded, assembled, and packed high-explosive ammunition; six other lines assembled ammunition components: primers,

boosters, fuzes, and detonators. Early in the war Elwood also produced ammonium nitrate at Group 61 (Buildings 61-1 through 61-29). This chemical was used as an extender to conserve scarce TNT. By 1944 the supply of TNT was adequate, and Group 61 was converted to a bomb and shell washout facility for reclaiming explosives from defective or surplus ammunition.

The load-assemble-and-pack process at Elwood consisted primarily of the final assembly of component parts and materials into complete ammunition. This process, common to all load, assemble, and pack facilities, has been described in the following way:

> The explosives, shell or bomb casings, cartridge cases, fuzes, primers, boosters, and detonators are received from outside manufacturers. They are then inspected and stored, until required, in the loading departments. The loading and assembling of these materials is carried on as an assembly-line process. Various departments or so-called "load lines" are maintained for the processing of each particular type of ammunition. Thus, a plant may have, in addition to one or more shell- or bomb-load lines, separate lines for loading such component parts as detonators, fuzes, primers, and boosters. . . .
>
> The main loading operation for shells and bombs is generally performed by either the melt-load or the press-load process. On the load line, the shell or bomb casings are cleaned, inspected and painted. Large-caliber shells and bombs are usually filled by the melt-load process, the major operation of which consists in screening, melting, and pouring the main explosive or bursting charge into the shell or bomb cavity. The most commonly used bursting charge is TNT, which is readily melted either alone or with ammonium nitrate. After the TNT has hardened, the booster and fuze are inserted. Some large-caliber shells are shipped to combat zones unfuzed, and the fuze is assembled in the field prior to firing the shell. In the case of fixed and semifixed rounds of ammunition, the projectile is assembled to the cartridge case, which contains the propellant charge and artillery primer. The final operations involve labeling and packing or crating for storage or shipment. Inspection is carried on continuously at each stage of the operation.

> The operations performed on the lines loading shells by the press-load process differ somewhat from those where the melt-loading process is used. The main explosive charge is loaded into the projectile in a dry, rather than molten state, and consolidated in to the shell by means of a hydraulic press. Press loading is most generally applied to smaller-caliber shells, such as those used in 20-mm and 40-mm cannon.
>
> The process of loading such component parts as fuzes, boosters, detonators, and primers is largely confined to very simple assembly work. Artillery primers, the bodies of which are metal tubes filled with a specified amount of black powder, are generally loaded on a volumetric loading machine. The heads, containing a small percussion element which ignites upon friction from the firing pin, are staked to the loaded bodies. Most of the operations on the primer-load lines are mechanized.
>
> The method of loading detonators, fuzes, and boosters varies somewhat from plant to plant, but in general the operations involve a large amount of bench assembly work. On the booster-loading line, for instance, each minute task is performed at long tables having numerous stations. Although most of the operations are performed by hand, small crimping and staking machines are used at the tables to assemble the various parts.[31]

Throughout the 1942-1945 period, ammunition production lines and machinery at Elwood were continually modified in response to changing materiel needs for the war effort. For example, the plant was originally planned to load 75-mm and 3" anti-aircraft rounds (Group 1, Buildings 1-1 through 1-34), but these were never made. Elwood did produce a number of different sizes of bombs and mines. But by the beginning of 1944 production was limited mainly to 105-mm Howitzer ammunition; one kind each of fuze, booster, primer, and detonator; an anti-tank mine dummy; and a demolition block. In May 1944 the plant began construction and renovation to allow the loading of 155-mm, 8", 240-mm, and addtional 105-mm projectiles.[32]

Elwood also responded to technological innovation, most notably by adopting the volumetric-multiple-pour-machine procedure for loading. In the plant's

three-story Melt and Pour Buildings (Buildings 1-4, 2-4, 3-4, 3A-4 / Figure 10), TNT flowed "by gravity from the transporters to melter, to the Dopp kettle [a hot-water-jacketed kettle at the second-floor level that maintained the molten TNT at a constant 177.1°F], to the tempering tanks, to the pouring machine and into the shells."[33] Volumetric-multiple-pour machines capable of simultaneously loading up to sixty shells were installed at Elwood after January 1945. Previously, the molten TNT was drawn from the Dopp kettles into first-floor tubs and then poured from hand-held buckets into the casings -- an inefficient, labor-intensive endeavor prone to error.

Du Pont operated Kankakee until April 1944, when U.S. Rubber Company of Akron, Ohio, took over. The government terminated operations at Kankakee in August 1945, and put the plant on standby in September. In November 1945 Kankakee and Elwood were combined and renamed Joliet Arsenal.[35] During the years immediately after World War II, JAAP remained on standby but was not entirely inactive: du Pont leased facilities in the Elwood Unit to produce ammonium nitrate for fertilizer.[36]

KOREAN WAR

After the Korean War began, the Army Corps of Engineers rehabilitated the Elwood and Kankakee Units. Both were in production by the beginning of 1952.

Kankakee, still operated by U.S. Rubber, produced TNT, DNT, tetryl, and lead azide as well as blue and red acid-resistant putty for ordnance plant

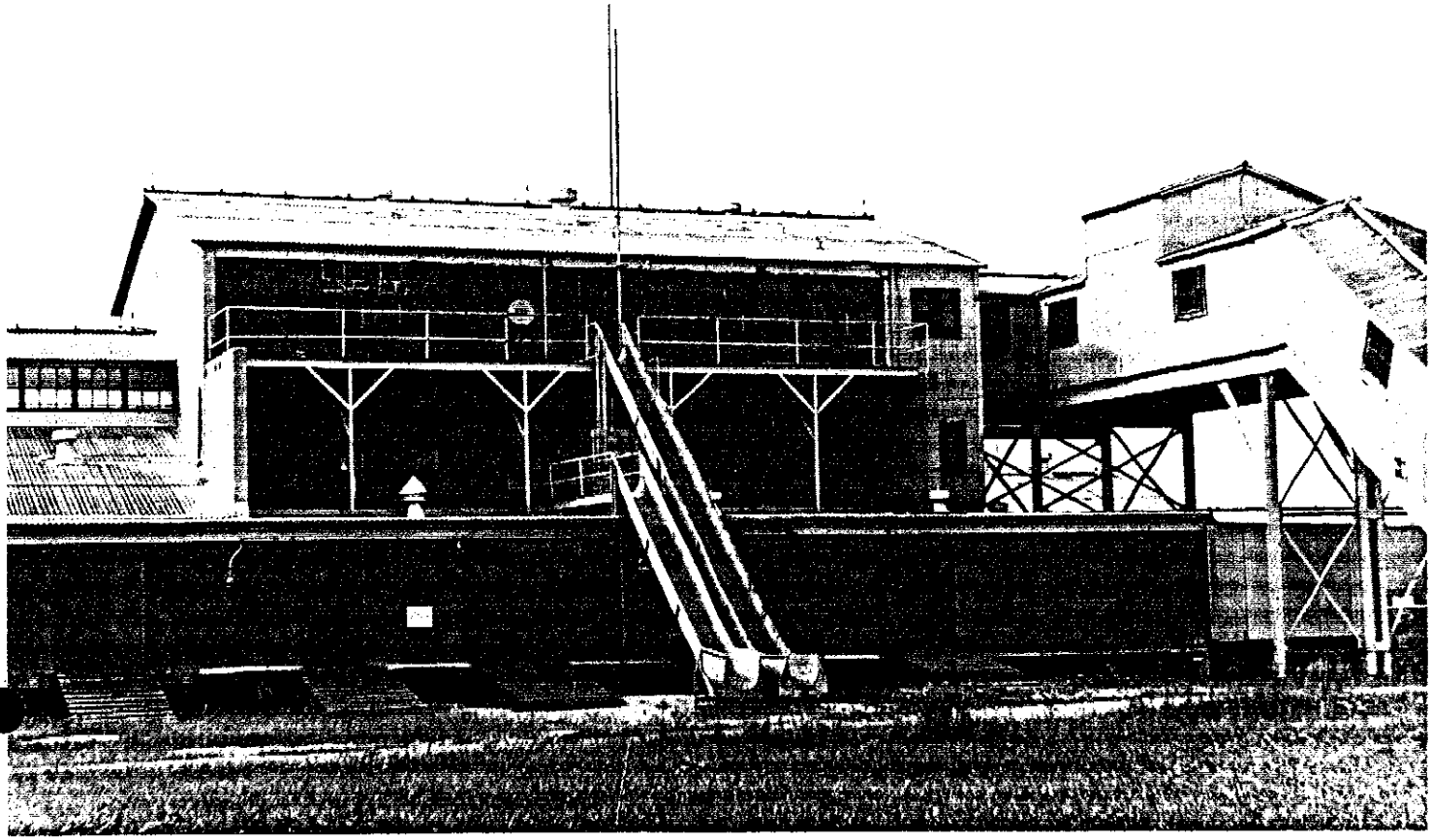

Figure 10: Group 1 Melt and Pour Building (Building 1-4). (Source: Field inventory photograph, Robert Ferguson, MacDonald and Mack Partnership, 1983)

use. Acid facilities were transferred from Kentucky Ordnance Works to increase production capacity (Buildings 308-3-4 through 308-3-6).[37] After an initial test on Line 12 in 1952, the TNT lines were mechanized. Later in the Korean War Kankakee became the site of a pilot plant for continuous nitration of TNT. The TNT lines continued to be plagued by the lack of facilities to dispose of the "redwater" waste created during the production process.[38]

The government operated the Elwood Unit during the Korean War, employing a maximum of 6,000 workers. The load, assemble, and pack operations included 57-mm, 70-mm, 90-mm, and 105-mm shells; anti-personnel mines; and fuzes, boosters, supplementary charges, and delay elements. Elwood continued production on a limited basis until 1965, when it was deactivated.[39]

During the Korean War many buildings in both units were rehabilitated. The only major new building constructed was an Administration Building (Building 703-1) in the Kankakee Unit, which became necessary when the Field Director of Ammunition Plants (FDAP) and later the Ordnance Ammunition Command (OAC) moved their headquarters to Joliet.[40]

VIETNAM WAR TO THE PRESENT

In August 1965 the Kankakee Unit of JAAP was reactivated, with U.S. Rubber as operating contractor, to supply explosives for use in Vietnam.[41] In 1966 the Kankakee Unit's major problem -- the disposal of toxic wastes -- was solved with the construction of a Redwater Treatment Facility

(Buildings 860-1 through 860-3). Here the waste from the TNT lines, containing toxic nitrotoluene compounds, was evaporated and burned.[42]

A modernization program aimed at addressing environmental problems and bringing manufacturing processes up to date began in 1970. Construction included a new acid area (Buildings 350-1, 353-1, 350-12) and a continuous-process TNT line (Buildings 870-1 through 870-6, 872-1 through 872-6, 873-1 through 873-6, 874-1 through 874-6, 875-1 through 875-6 / Figure 11). The acid area (Figure 12), incorporating sulfuric acid regeneration, ammonia oxidation, and direct strong nitric acid production, was functional by the end of 1975.[43]

The production of TNT by a continuous process, rather than by the batch method, represented a major technological advancement. While the daily outputs were approximately equal, the continuous process offered advantages in the areas of cleanliness, reduced pollution, labor savings, and greater control over the process. The continuous process lines at JAAP employed techniques developed and refined both there and at other locations. In the continuous production process, the nitration takes place in a series of small interconnected tanks. Acid and toluene are continuously fed into the first tank where they are agitated to cause partial nitration. As more raw materials are added, they force the partially nitrated materials into the next tank, where additional acid is fed into the mix to continue the nitration process. Incoming materials continue to move the reacting materials through the system until nitration is complete. The unpurified TNT is then washed and piped to a Finishing House for drying, flaking, and packing.[44]

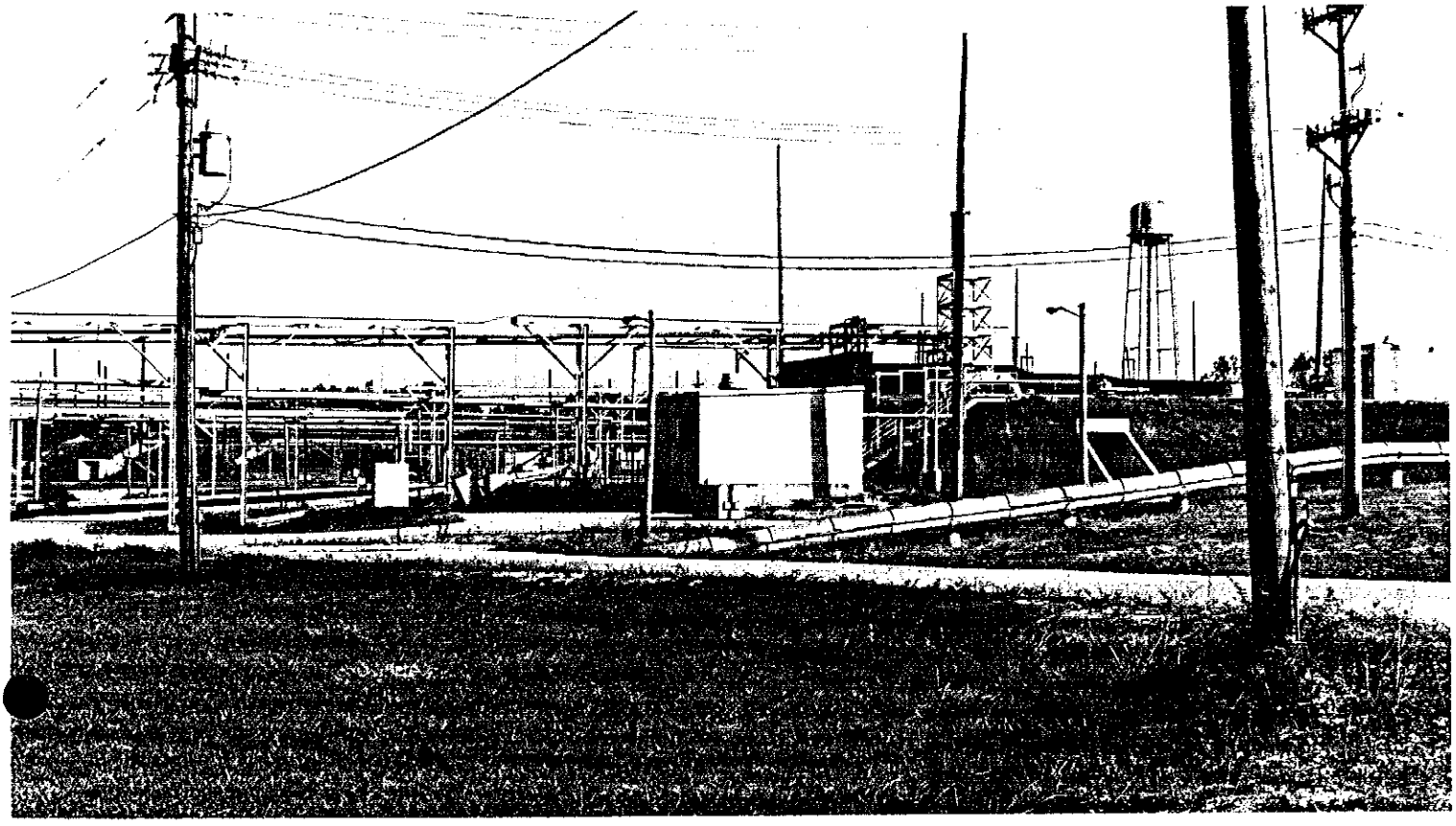

Figure 11: Continuous Process TNT Building (Building 875-5). (Source: Field inventory photograph, Peter Rathbun, MacDonald and Mack Partnership, 1983)

Figure 12: Ammonia Oxidation Plant (Building 353-1), new (1970-1975) acid area. (Source: Field inventory photograph, Peter Rathbun, MacDonald and Mack Partnership, 1983)

The command structure of the Ordnance Ammunition Command split in 1962; one of the newly organized administrative units, the Munitions Command and the Armament Procurement and Supply Agency (APSA), remained at JAAP. In 1970 APSA built a large new training center (Building 702-1) in the Kankakee Unit.[45] APSA eventually merged with other agencies, and the personnel were tansferred to Rock Island Arsenal, Rock Island, Illinois, in 1973.

The Elwood Unit of JAAP was reactivated in August 1966, under the operation of U.S. Rubber. By December, 105-mm rounds were in production. Peak production and employment came in 1967. By 1968 the plant was producing 8" Naval ammunition, supplementary charge assemblies, and cluster bomb units in addition to 105-mm shells.[46]

Since the Vietnam War, Honeywell Corporation has used the component assembly groups (Groups 5 through 9) at Elwood, and has altered some of the buildings.

NOTES

1. For the sake of clarity and brevity the plant's current name is used throughout this report when both facilities are referred to collectively.

2. Joliet Army Ammunition Plant, "DARCOM Installation and Activity Brochure" (unpublished brochure, 1977), pp. 1-4.

3. Although the Real Property Inventory Printouts of 31 March 1982 for the Kankakee and Elwood Units of JAAP indicate 1,476 buildings, the author has eliminated sheds, well houses, and sentry houses from the figures to allow comparison with the figures from the 1940s, which include only substantial buildings. 1,247 of these were originally built. U.S. Army Materiel Development and Readiness Command (DARCOM), "Joliet AAP Kankakee Real Property Inventory Printout" (computer printout, 31 March 1982); DARCOM, "Joliet AAP Elwood Real Property Inventory Printout" (computer printout, 31 March 1982); U.S. Army Corps of Engineers, Office of the District Engineer, Chicago, "Industrial

Facilities Inventory, Kankakee Ordnance Works" (unpublished report, 1943, at U.S. Army Armament, Munitions and Chemical Command (AMCCOM) Historical Office, Rock Island Arsenal, Rock Island, Illinois); U.S. Army Corps of Engineers, "Industrial Facilities Inventory, Elwood Ordnance Plant" (unpublished report, 1943, at AMCCOM Historical Office); U.S. Army Corps of Engineers, "Industrial Facilities Inventory, Kankakee Ordnance Works, Supplement #1" (unpublished report, 1945, at AMCCOM Historical Office); U.S.Army Corps of Engineers, "Industrial Facilities Inventory, Kankakee Ordnance Works, Supplement #2" (unpublished report, 1947, at AMCCOM Historical Office).

4. Harry C. Thompson and Lida Mayo, The Ordnance Department: Procurement and Supply (Washington, D.C.: Office of the Chief of Military History, Department of the Army, 1960), pp. 104-105.

5. Lenore Fine and Jesse A. Remington, The Corps of Engineers: Construction in the United States (Washington, D.C.: Office of the Chief of Military History, United States Army, 1972), pp. 315-316; Thomson and Mayo, p. 110.

6. William Voight, Jr., "The Ordnance Organization in World War II" (unpublished report, 1945, at AMCCOM Historical Office), pp. 309-310; A. Robert Ginsburgh, "Chemical Munitions Plants: A Lesson in Economic Geography," Chemical & Metallurgical Engineering, 47 (November 1940), 768-769, 784; Thomson and Mayo, p. 108.

7. "Defense Comes to Main Street," Business Week, November 2, 1940, p. 20; "DARCOM Brochure," p. 19; interviews with Arnold Kiser, of the government staff, JAAP, 4 and 6 October 1983. Since the acquisition of the site, a number of perimeter tracts of land have been transferred from government ownership, including sizeable sections sold to private industry and to the State of Illinois for the Des Plaines Conservation Area. The land purchased in 1940-1941 comprised 15,328 acres for Elwood Ordnance Plant and 20,860 acres for Kankakee Ordnance Works; current acreages are 14,385 and 9,159, respectively. U.S. Congress, Senate, Report of the Committee on Government Operations, Report No. 565, 86th Congress, 1st Session, 1959, pp. 1-8; "Facilities Inventory, Elwood;" "Facilities Inventory, Kankakee;" Kiser interview.

8. Sidney D. Kirkpatrick, "From Farmlands to TNT and Munitions Works," Chemical & Metallurgical Engineering, 48 (May 1941), 125; "Facilities Inventory, Elwood," Part I, Sec. 1, p. 1; "Facilities Inventory, Kankakee," Part I, Sec. 1, p. 1.

9. See C. H. Cotter, "Naval Ammunition Depot Near Hawthorne, Nev., Built to Serve the Pacific Coast," Engineering News-Record, 105 (November 20, 1930), 803-805; Paul Nissen, "Igloos of Concrete," Pacific Builder and Engineer, 47 (September 1941), 40-44; Fine and Remington, pp. 333-334.

10. Hercules Powder Company, "VOW: TNT Lnes -- Building 802 -- 1-12" (unpublished construction drawings dated August 1941, on file at AMCCOM Historical Office, Rock Island Arsenal); "Facilities Inventory, Elwood;" "Facilities Inventory, Kankakee."

11. Lester F. Filson, "From Whence Came a City" (unpublished manuscript, 1957, Joliet Public Library), p. XIV-2; Fine and Remington, p. 316.

12. "Facilities Inventory, Elwood," Part I, Sec. 11, p. 1.

13. Fine and Remington, p. 339.

14. "Facilities Inventory, Kankakee."

15. "Facilities Inventory, Elwood."

16. George D. Rogers, "Military Explosives," National Safety News, (July 1941), 22-23, 77-80; John R. Mardick, "Safety's Triangle," Safety Engineering (16 April 1942), 13-14; U.S. Rubber Company, "Tetryl Area, Quantity Distances" (unpublished map, contractor files JAAP); U.S. Rubber Company, "TNT Area, Quantity Distances" (unpublished map, contractor files, JAAP); Thomson and Mayo, pp. 130-133.

17. Filson, p. XIV-3.

18. "Facilities Inventory, Kankakee," Part II, Section 1, p. 2.

19. "Production of Our End Product: Tetryl" (unpublished diagram, n.d., contractor files, JAAP); "Production of Our End Product: Sp. Pur. Lead Azide" (unpublished diagram, n.d., contractor files, JAAP).

20. "IAAP [Indiana Army ammunition Plant] Chemical Division Manual," Section II (Acid), p. 4 (unpublished document, n.d., in ICI Americas Archives, Indiana Army Ammunition Plant, Charlestown, Indiana.

21. R. Norris Shreve, The Chemical Process Industries (New York: McGraw-Hill, 1956), pp. 383-392; Thomson and Mayo, pp. 134-135.

22. Shreve, pp. 277-383.

23. Interview with Richard Twitchell, engineer at Volunteer Army Ammunition Plant, 27 September 1983; "Production of Our End Product: TNT" (unpublished diagram, n.d., contractor files, JAAP; Jules Bebie, "Making Explosives For World War II," Chemical & Metallurgical Engineering, 48 (October 1941), 6-8; Hercules Powder Company, "Historical Record: Volunteer Ordnance Works" (unpublished report, 1944, in Chattanooga Public Library); "Making T.N.T.: Electrical Aspects of a Large Factory,"

Electrical Review, 136 (2 February 1945), 153-157; Shreve, pp. 458-459; Rogers, pp. 22-23, 77-79.

24. Twitchell interview; Bebie; "Historical Record: Volunteer;" "Making T.N.T.;" Shreve; Rogers.

25. Philip J. Raifsnider, "New Techniques Improve TNT Manufacture," Chemical Industries, 57 (December 1945), 1054-1056; Thomson and Mayo, pp. 134-135.

26. "Facilities Inventory, Kankakee, Supplement No. 1," Part I, Sec. 1, pp. 1-2. Toluene is an organic compound made up of a methyl or alcohol group attached to benzene, a simple ring molecule; xylene is benzene with two methyl groups. Robert T. Morrison and Robert N. Boyd, Organic Chemistry (Boston: Allyn and Bacon, 1969), pp. 370-384.

27. Kiser, tour of DNT line, 6 October 1983; "Production of Our End Product: DNT."

28. Kiser, tour of tetryl line, 6 October 1983; "Production of Our End Product: Tetryl;" "Facilities Inventory, Kankakee."

29. "Production of Our End Product: Sp. Pur. Lead Azide;" "Facilities Inventory, Kankakee," Part II, Sec. 1, p. 2.

30. Bebie, pp. 6-8.

31. "Hourly Earnings in the Ammunition-Loading Industry, 1944," Monthly Labor Review, 60 (April 1945), 840-841.

32. "Facilities Inventory, Elwood," Part II, Sec. 1; "Facilities Inventory, Elwood, Supplement No. 1," Part I, Sec. 1.

33. L. A. Quayle, "Volumetric Pouring Machine," Mechanical Engineering, 67 (September 1945), 599-606; "Army Develops Mechanical Shell Loading," Chemical & Metallurgical Engineering 52 (April 1945), 99.

34. Voight, p. 56.

35. Voight, p. 56; "DARCOM Brochure," pp. 1-2.

36. Filson, p. XIV-5.

37. [Joliet arsenal, Kankakee Unit], "Historical Report" (unpublished series of reports issued semi-annually until 1961, contractor files, JAAP), January-June 1952, pp. 75-76; January-June 1953, pp. 4, 35; "DARCOM Brochure," p. 2.

38. "Historical Report," January-June 1952; January-June 1953; January - June 1954 through July - December 1961 inclusive; "DARCOM Brochure," p. 2.

39. R. J. Hammond, "Profile on Munitions, 1950-1977" (unpublished report prepared for the Ordnance Department, n.d., on microfiche, AMCCOM Historical Office, Rock Island Arsenal), p. 57.

40. "Historical Report," July-December 1953, p. 3.

41. "DARCOM Brochure," pp. 2-3; Hammond, p. 87.

42. Joliet Army Ammunition Plant, "Annual Historical Report" (unpublished annual report from 1966 - present, contractor files, JAAP), 1966; C. C. Ruchhoft, M. LeBosquet, Jr., and William G. Meckler, "TNT Wastes from Shell-Loading Plants," Industrial and Engineering Chemistry, 37 (October 1945), 937-943; Russell S. Smith and W. W. Walker, "Surveys of Liquid Wastes from Munitions Manufacturing," Public Health Reports, 58 (10 September 1943), 1365-1373; Hammond, pp. 88-89; Rogers, pp. 77-79.

43. Walter E. Berl, "Explosives," Chemical 7 Metallurgical Engineering, 52 (May 1945), 202, 204, 206; "Annual Historical Report," 1970, 1973, 1974, 1975; Twitchell interview.

44. Twitchell interview.

45. "Annual Historical Report," 1970, p. 66.

46. "Annual Historical Report," 1968; Hammond, p. 57.

Chapter 3

PRESERVATION RECOMMENDATIONS

BACKGROUND

Army Regulation 420-40 requires that an historic preservation plan be developed as an integral part of each installation's planning and long-range maintenance and development scheduling.[1] The purpose of such a program is to:

- Preserve historic properties to reflect the Army's role in history and its continuing concern for the protection of the nation's heritage.
- Implement historic preservation projects as an integral part of the installation's maintenance and construction programs.
- Find adaptive uses for historic properties in order to maintain them as actively used facilities on the installation.
- Eliminate damage or destruction due to improper maintenance, repair, or use that may alter or destroy the significant elements of any property.
- Enhance the most historically significant areas of the installation through appropriate landscaping and conservation.

To meet these overall preservation objectives, the general preservation recommendations set forth below have been developed:

Category I Historic Properties

All Category I historic properties not currently listed on or nominated to the National Register of Historic Places are assumed to be eligible for

nomination regardless of age. The following general preservation recommendations apply to these properties:

a) Each Category I historic property should be treated as if it were on the National Register, whether listed or not. Properties not currently listed should be nominated. Category I historic properties should not be altered or demolished. All work on such properties shall be performed in accordance with Sections 106 and 110(f) of the National Historic Preservation Act as amended in 1980, and the regulations of the Advisory Council for Historic Preservation (ACHP) as outlined in the "Protection of Historic and Cultural Properties" (36 CFR 800).

b) An individual preservation plan should be developed and put into effect for each Category I historic property. This plan should delineate the appropriate restoration or preservation program to be carried out for the property. It should include a maintenance and repair schedule and estimated initial and annual costs. The preservation plan should be approved by the State Historic Preservation Officer and the Advisory Council in accordance with the above-referenced ACHP regulation. Until the historic preservation plan is put into effect, Category I historic properties should be maintained in accordance with the recommended approaches of the Secretary of Interior's Standards for Rehabilitation and

Revised Guidelines for Rehabilitating Historic Buildings[2] and in consultation with the State Historic Preservation Officer.

c) Each Category I historic property should be documented in accordance with Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) Documentation Level II, and the documentation submitted for inclusion in the HABS/HAER collections in the Library of Congress.[3] When no adequate architectural drawings exist for a Category I historic property, it should be documented in accordance with Documentation Level I of these standards. In cases where standard measured drawings are unable to record significant features of a property or technological process, interpretive drawings also should be prepared.

Category II Historic Properties

All Category II historic properties not currently listed on or nominated to the National Register of Historic Places are assumed to be eligible for nomination regardless of age. The following general preservation recommendations apply to these properties:

a) Each Category II historic property should be treated as if it were on the National Register, whether listed or not. Properties not currently listed should be nominated. Category II historic properties should not be altered or demolished. All work on such properties shall be performed

in accordance with Sections 106 and 110(f) of the National Historic Preservation Act as amended in 1980, and the regulations of the Advisory Council for Historic Preservation (ACHP) as outlined in the "Protection of Historic and Cultural Properties" (36 CFR 800).

b) An individual preservation plan should be developed and put into effect for each Category II historic property. This plan should delineate the appropriate preservation or rehabilitation program to be carried out for the property or for those parts of the property which contribute to its historical, architectural, or technological importance. It should include a maintenance and repair schedule and estimated initial and annual costs. The preservation plan should be approved by the State Historic Preservation Officer and the Advisory Council in accordance with the above-referenced ACHP regulations. Until the historic preservation plan is put into effect, Category II historic properties should be maintained in accordance with the recommended approaches in the Secretary of the Interior's Standards for Rehabilitation and Revised Guidelines for Rehabilitating Historic Buildings[4] and in consultation with the State Historic Preservation Officer.

c) Each Category II historic property should be documented in accordance with Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) Documentation Level

II, and the documentation submitted for inclusion in the HABS/HAER collections in the Library of Congress.[5]

Category III Historic Properties

The following preservation recommendations apply to Category III historic properties:

a) Category III historic properties listed on or eligible for nomination to the National Register as part of a district or thematic group should be treated in accordance with Sections 106 and 110(f) of the National Historic Preservation Act as amended in 1980, and the regulations of the Advisory Council for Historic Preservation as outlined in the "Protection of Historic and Cultural Properties" (36 CFR 800). Such properties should not be demolished and their facades, or those parts of the property that contribute to the historical landscape, should be protected from major modifications. Preservation plans should be developed for groupings of Category III historic properties within a district or thematic group. The scope of these plans should be limited to those parts of each property that contribute to the district or group's importance. Until such plans are put into effect, these properties should be maintained in accordance with the recommended approaches in the Secretary of the Interior's Standards for Rehabilitation and Revised

Guidelines for Rehabilitating Historic Buildings[6] and in consultation with the State Historic Preservation Officer.

b) Category III historic properties not listed on or eligible for nomination to the National Register as part of a district or thematic group should receive routine maintenance. Such properties should not be demolished, and their facades, or those parts of the property that contribute to the historical landscape, should be protected from modification. If the properties are unoccupied, they should, as a minimum, be maintained in stable condition and prevented from deteriorating.

HABS/HAER Documentation Level IV has been completed for all Category III historic properties, and no additional documentation is required as long as they are not endangered. Category III historic properties that are endangered for operational or other reasons should be documented in accordance with HABS/HAER Documentation Level III, and submitted for inclusion in the HABS/HAER collections in the Library of Congress.[7] Similar structures need only be documented once.

CATEGORY I HISTORIC PROPERTIES

There are no Category I historic properties at the JAAP.

CATEGORY II HISTORIC PROPERTIES

There are no Category II historic properties at the JAAP.

CATEGORY III HISTORIC PROPERTIES

TNT Production Facilities

(Buildings 801-7, 803-7, 802-7, 812-7, 806-7, 808-4)

. Background and significance. TNT was the most important high explosive used in bombs, mines, and ammunition in World War II. Government-owned, contractor-operated ordnance works like JAAP produced almost all of the TNT for the U.S. war effort. The Kankakee Unit at Joliet, the first TNT works authorized, remained the nation's major producer during the war. Today, buildings and equipment of Line 7 are substantially the same as they were at the end of the war. By that time the line had been modified to use the reverse nitration process: the Fortifier House (Building 803-7) had been altered into a Bi House and the Bi-and-Tri House (Building 802) had been modified to a Tri House. (See description of processes in Chapter 2, World War II Technology.) The facilities were modified again during reactivation for both the Korean and Vietnam wars, but they remain substantially intact as constructed in 1941. The major TNT production buildings in Line 7 of TNT Area 4 at JAAP are Category III historic properties because they have

importance as the first of a widely used industrial process, and because they are a highly intact historic engineering type. They do not presently meet the criteria for nomination to the National Register of Historic Places of properties less than fifty years old, but should be re-evaluated at a later date.

- Condition and potential adverse impacts. The TNT production buildings in Line 7 at the JAAP are in very good physical condition and undergo routine maintenance and repair as part of standby activity at the plant. There are no current plans to alter or demolish these properties.

- Preservation options. Refer to the preservation recommendations for Category III historic properties listed at the beginning of this chapter.

NOTES

1. Army Regulation 420-40, Historic Preservation (Headquarters, U.S. Army: Washington, D.C., 15 April 1984).

2. National Park Service, Secretary of Interior's Standards for Rehabilitation and Revised Guidelines for Rehabilitating Historic Buildings, 1983 (Washington, D.C.: Preservation Assistance Division, National Park Service, 1983).

3. National Park Service, "Archeology and Historic Preservation; Secretary of the Interior's Standards and Guidelines," Federal Register, Part IV, 28 September 1983, pp. 44730-44734.

4. National Park Service, Secretary of the Interior's Standards.

5. National Park Service, "Archeology and Historic Preservation."

6. National Park Service, Secretary of the Interior's Standards.

7. National Park Service, "Archeology and Historic Preservation."

BIBLIOGRAPHY

Published Sources

Applied Science and Technology Index. 1958-1980.

"Army Develops Mechanical Shell Loading." Chemical & Metallurgical Engineering, 52 (April 1945), 99. Brief article with diagrams explaining the volumetric loading machine.

Bebie, Jules. "Making Explosives For World War II." Chemical & Metallurgical Engineering, 48 (October 1941), 6-8. Brief overview of explosive production early in the war.

Berl, Walter E. "Explosives." Chemical & Metallurgical Engineering,52 (May 1945), 202,204,206. A discussion of the use of continuous processing for the manufacture of explosives.

Cotter, C. H. "Naval Ammunition Depot Near Hawthorne, Nev., Built to Serve the Pacific Coast." Engineering News-Record, 105 (20 November 1930), 803-805. A discussion of the design and spacing of magazines.

"Defense Comes to Main Street." Business Week, 2 November 1940, pp. 19-25. Outlines the impact of a defense plant on the area.

Engineering Index. 1938-1983.

Fine, Lenore, and Remington, Jesse A. The Corps of Engineers: Construction in the United States. Washington, D.C.: Office of the Chief of Military History, United States Army, 1972. Good overview of the conditions affecting construction of ordnance works during the war.

Ginsburgh, A. Robert. "Chemical Munitions Plants: A Lesson in Economic Geography." Chemical & Metallurgical Engineering, 47 (November 1940), 768-769, 784. Gives the rationale for the location of ordnance plants.

Higham, Robin ed. A Guide to the Sources of United States Military History. Hamden, Conn.: 1975.

"Hourly Earnings in the Ammunition-Loading Industry, 1944." Monthly Labor Review, 60 (April 1945), 840-841. Good, brief explanation of the operations of a load, assemble, and pack plant.

Hoy, Suellen M., and Robinson, Michael C., eds. Public Works History in the United States. Nashville: American Association for State and Local History, 1982.

Industrial Arts Index. 1938-1957.

Jessup, John E. and Robert W. Coakley. A Guide to the Study and Use of Military History. Washington: 1979.

Kirkpatrick, Sidney D. "From Farmlands to TNT and Munitions Works." Chemical & Metallurgical Engineering, 48 (May 1941), 125-127. Outlines the mission of JAAP as seen early in construction.

"Making T.N.T.: Electrical Aspects of a Large Factory." Electrical Review, 136 (February 2, 1945), 153-157. Although concerned primarily with electrical machinery, this articla covers the process equipment as well.

Mardick, John R. "Safety's Triangle." Safety Engineering, 16 April 1942, pp. 13-14. Addresses the issue of safety at ordnance plants.

Morrison, Robert T., and Boyd, Robert N. Organic Chemistry. Boston: Allen and Bacon, 1966.

National Park Service. "Archeology and Historic Preservation; Secretary of the Interior's Standards and Guidelines." Federal Register, Part IV (28 September 1983), 44730-44734.

_____. How to Complete National Register Forms. Washington, D.C.: U.S. Government Printing Office, January, 1977.

_____. Secretary of the Interior's Standards for Rehabilitation and Revised Guidelines for Rehabilitating Historic Buildings, 1983. Washington, D.C.: Preservation Assistance Division, National Park Service, 1983.

Nissen, Paul. "Igloos of Concrete." Pacific Builder and Engineer, 47 (September 1941), 40-44. Covers the construction of explosives storage magazines.

Quayle, L. A. "Volumetric Pouring Machine." Mechanical Engineering, 67 (September 1945), 599-606. Good discussion of new mechanized approach to shell loading.

Raifsnider, Philip J. "New Techniques Improve TNT Manufacture." Chemical Industries, 57 (December 1945), 1054-1056. Explains the impact of reverse nitration and other improvements on TNT production.

Rogers, George D. "Military Explosives." National Safety News, July 1941, pp. 22-23, 77-80. Examines both construction and operating safety issues and methods.

Ruchhoft, C. C.; LeBosquet, M. Jr.; and Meckler, William G. "TNT Wastes from Shell-Loading Plants." Industrial and Engineering Chemistry, 37 (October 1945), 937-943. Discusses the disposal of redwater waste.

Shreve, R. Norris. The Chemical Process Industries. New York: McGraw-Hill, 1956. Detailed explanation of the production of both nitric and sulfuric acids.

Slachman, P. G. "Procurement of Raw Materials for High Explosives." Chemical & Metallurgical Engineering, 52 (October 1945), 113-114.

Smith, Russell S., and Walker, W. W. "Surveys of Liquid Wastes from Munitions Manufacturing." Public Health Reports, 58 (10 September 1943), 1365-1373. Report of investigations into redwater.

Thompson, Harry C., and Mayo, Lida. The Ordnance Department: Procurement and Supply. Washington, D.C.: Office of the Chief of Military History, Department of the Army, 1960.

United States Army Armament Materiel Readiness Command. Catalog of Common Sources, Fiscal Year 1983. No. pl.: Historical Office, AMCCOM, Rock Island Arsenal, Rock Island, Ill.

U.S. Congress, Senate. Report of the Committee on Government Operations. Report No. 565, 86th Congress, 1st Session, 1959, pp. 1-8. Discussion of a bill to sell land to the state of Illinois.

Unpublished Sources

AMCCOM. Catalog of Common Sources, Fiscal Year 1983. 2 vols. No pl., AMCCOM Historical Office, Rock Island Arsenal, Rock Island, Ill., n.d. Catalog of documents on microfiche.

Filson, Lester F. "From Whence Came A City." Manuscript, 1957. Joliet Public Library, Joliet, Ill. Discusses the construction and highlights of events at JAAP.

Hammond, R. J. "Profile on Munitions, 1950-1977." Report prepared for the Ordnance Department, n.d., on microfiche, AMCCOM Historical Office, Rock Island Arsenal, Rock Island, Ill.

Hercules Powder Co. "Historical Record: Volunteer Ordnance Works." Report, 1944, Chattanooga Public Library, Chattanooga, Tenn. Presents an outline of the construction and operation of VAAP.

_____. "VOW: TNT Lines -- Building 802 - 1-12." Two construction drawings dated August 1941. AMCCOM Historical Office, Rock Island Arsenal, Rock Island, Ill.

Historic American Buildings Survey / Historic American Engineering Record, National Park Service. Guidelines for Inventories of Historic Buildings and Engineering and Industrial Structures. Unpublished draft, 1982.

[Joliet Army Ammunition Plant.] "Annual Historical Report." Annual report from 1966 to the present. Contractor files, JAAP.

_____. "DARCOM Installation and Activity Brochure." 1977. Administration Building, JAAP.

Joliet Arsenal, Kankakee Unit. "Historical Report." Series of reports issued semiannually from 1952 to 1961. Contractor files, JAAP. In-depth review of plant operations.

"Production of Our End Product - DNT." Diagram, n.d. Contractor files, JAAP.

"Production of Our End Product - Sp. Pur. Lead Azide." Diagram, n.d. Contractor files, JAAP.

"Production of Our End Product - Tetryl." Diagram, n.d. Contractor files, JAAP.

"Production of Our End Product - TNT." Diagram, n.d. Contractor files, JAAP.

U.S. Army Corps of Engineers, Office of the District Engineer, Chicago. "Industrial Facilities Inventory, Elwood Ordnance Plant." Report, 1943. AMCCOM Historical Office, Rock Island Arsenal, Rock Island, Ill.

_____. "Industrial Facilities Inventory, Elwood Ordnance Plant, Supplement No. 1. Report, 1945. AMCCOM Historical Office, Rock Island Arsenal, Rock Island, Ill.

_____. "Industrial Facilities Inventory, Kankakee Ordnance Works." Report, 1943. AMCCOM Historical Office, Rock Island Arsenal, Rock Island, Ill.

_____. "Industrial Facilities Inventory, Kankakee Ordnance Works, Supplement No. 1." Report, 1945. AMCCOM Historical Office, Rock Island Arsenal, Rock Island, Ill.

_____. "Industrial Facilities Inventory, Kankakee Ordnance Works, Supplement No. 2." Report, 1947. AMCCOM HIstorical Office, Rock Island Arsenal, Rock Island, Ill.

U.S. Army Materiel Development and Readiness Command (DARCOM). "Joliet AAP Elwood Real Property Inventory Printout." Computer printout, 31 March 1982.

_____. "Joliet AAP Kankakee Real Property Inventory Printout." Computer printouot, 31 March 1982.

U.S. Army Munitions Command. Modernization Engineering Report for U.S. Army Ammunition Plants. U.S. Army Munitions Command, Dover New Jersey, August 1970. Describes capabilities and status of AAPs as of 1970.

U.S. Rubber Company. "Tetryl Area, Quantity Distances." Map, n.d. Contractor files, JAAP.

_____. "TNT Area, Quantity Distances." Map, n.d. Contractor files, JAAP.

Voight, William, Jr. "The Ordnance Organization in World War II." Report, 1945. On microfiche, AMCCOM HIstorical Office, Rock Island Arsenal, Rock Island, Ill.